LEGAL REGULATION OF SPACE SOLAR POWER

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Space Solar Power (SSP) will be a world project having vast international and national legal ramifications. Success of a SSP program will depend on the skill with which a legal framework is established for SSP construction and operation. Thus it may be useful to examine SSP in light of current international political and legal matters, including specifically international space law and national space legislation.

This study has two major limitations. First, this study is rendered somewhat futile because SSP will absolutely require new laws and treaties. Such new legislation will have as its object specific jurisdiction over SSP. Proper development of new legal norms and instruments may benefit from a review of current space laws having jurisdiction over the construction and operations of an SSP system. Second, this study is incomplete because it deals only with space law. SSP will deeply engage all aspects of the great seamless web of human law, because it will be a vast human endeavor. These topics are beyond the scope of this study, which is limited to space law.

A number of existing international organizations, having both scientific and technical competence and a political-legal orientation, are involved in the governance of space objects orbiting at geostationary heights. The public international institutions include the United Nations, and in particular, the Committee on the Peaceful Uses of Outer Space (COPUS), and the International Telecommunication Union (ITU). A private international institution with a scientific focus is the Committee on Space Research (COSPAR) of the International Council of Scientific Unions (ICSU).

The United Nations has been instrumental in the preparation of three international agreements that bear directly on the uses of outer space, the Moon and celestial bodies (the space environment) by a SSP. These are the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and other Celestial Bodies; the 1972 Convention on International Liability for Damage Caused by Space Objects and the Moon Agreement of 1979.

The United States is a party to the 1967 and 1972 agreements, and they have entered into force. As a chief proponent of these two major international legal instruments, the United States has sought to assure the full and free use of the space environment for all peaceful purposes. These agreements have been premised on the res communis international legal principle. Thus, the space environment is open for

the use of all who are able to use it. It cannot become an area subject to the sovereignty of a nation state.

The Liability Convention is intended to prevent against misuse of the space environment. It provides that monetary damages will compensate for misuse.

Neither the United States nor any spacefaring nation has become a party to the Moon Treaty. Most space legal experts believe it should be either amended or abolished. The Moon Treaty applies to "other celestial bodies within the solar system" including the Sun as stipulated in Article I (1).

Solar energy has been regarded as a natural resource and common heritage of mankind as indicated by Article XI (1). Since all space faring states have freely used solar energy in space by equipping solar panels onto artificial satellites or on the ISS without any objection from other states, the utilization of space solar energy is internationally and customarily legal, even under the Moon Treaty.

Since the 1967 Treaty preserves the right to the free use of the space environment, States and others having the capacity to do so are entitled to make use of geostationary orbital positions. However, a formal definition/delimitation of sovereign airspace and non-sovereign space environment does not exist. Consequently, in 1976 eight equatorial States issued the Bogota Declaration. In this they asserted that the spatial area superjacent to their territorial areas was airspace and subject to their sovereignty. The space-resource States and others have rejected this claim.

> The International Telecommunications Union (ITU), pursuant to the Telecommunication Convention and Final Protocol, continues to make allocations of radio frequencies. There has been a trend at the ITU to link the radio spectrum with the geostationary orbital position. There is no question that the ITU is charged with making microwave frequency allocations. However, such allocations depend upon the national assignments of such frequencies which are recorded with the ITU. The ITU continues to be responsible for preventing harmful interferences by competing broadcasts. It remains to be seen whether the UN, the ITU, or a new international entity will be given the principal responsibility for protecting national and international wants and needs for the efficient, economic, and equitable use of a SSP.

International law has not established international microwave exposure standards. Nonetheless, the Liability Convention has established international tort law rules. If microwave transmissions of energy from geostationary levels were to cause harm to plants, animals, and tangible items, the Convention would cover the subject.

In addition, bilateral or multilateral governmental guidelines are also possible legal instruments that can be used to implement the SSP project like the various Inter-Governmental Agreements (IGA) or Memorandum of Understanding (MoU) used for the ISS. Another important considerations is the impact of the space transportation

component upon SSP's legality. Reusable Launch Vehicles (RLVs) will be required to fly many times a day to establish and maintain the envisioned SSP operational schedule. Currently, the United States has to inform the state of Russia 24 hours before a launch according to previously signed missile treaties. However, launch frequencies for SSP will be on the order to every few hours and new mechanisms have to be established to offer simultaneous or no launch information to other relevant states of concern.

If the nationality of multinational enterprise is fixed within US, national space laws would be applicable to conduct launching and operating SSP, to the extent that they are not against international law. The US Commercial Space Launch Act is applicable for launching, and if the US government contracts for the manufacturer of SSP, the negligence of construction would be the matter of governmental immunity, in other words, the US Federal Torts Claim Act would not be applicable".

However, as long as SSP is an international project such as one between Japan and the U.S., nation states would conduct IGAs and MoUs first to implement their responsibility, and then their private entities would conduct agreements with continued supervision by the appropriate state party pursuant to Article VI of the 1967 Outer Space Treaty. However, these specific and detailed agreements for concrete projects are beyond the scope of this study because SSP is not yet mature enough to require such agreements.

SSP may also look to other agencies from which to derive a workable model of SSP organization. These include analogues to the International Atomic Energy Agency (IAEA) or Intelsat," These analogues considered IAEA as a possible model since its purpose includes the production of electrical energy and peaceful purposes related to energy. Other examples have looked to manner in which INTELSAT has established a successful international commercial .

This article also summarizes the national space laws of several nations (Argentina, Australia, Japan, Russia, Great Britain, the United States, Ukraine and Sweden), as examples of how states have integrated the international space law into their national legislation.

Is it practical to expect that there is enough money to pay for a SSP system?

To give some feeling for the shear economic size of this work, it is instructive to estimate the world's future need for electric power

At least $1 trillion of new electricity-generating capacity will be purchased globally during the period 1997- 2010. Renewable energy technology exports in the United States already exceed $350 million per year. Such generating technologies will be vital to developing nations such as China and India, where energy demand is rising at 10% a year, but where the environmental impact of power production is of great concern.

Clearly, the traditional and new energy technologies are generating huge volumes of business for companies that know where the opportunities lie, both geographically and by product line. At present, total installed generating capability around the world is approximately 2,900,000 megawatts. In order to meet even present demands for electricity, not to mention the forecasted growth in world economies, generating capability will have to increase substantially.

In the *International Energy Outlook 2002* (*IEO2002*) reference case, worldwide electricity consumption is projected to increase at an average annual rate of 2.7 percent from 1999 to 2020. The most rapid growth in electricity use is projected for the developing world, particularly developing Asia, where electricity consumption is expected to increase by 4.5 percent per year over the forecast horizon. Robust economic growth in developing Asia is expected to lead to increased demand for electricity to run newly purchased home appliances, such as air conditioners, refrigerators, stoves, space heaters, and water heaters.

By 2020, developing Asia is expected to consume more than twice as much electricity as it did in 1999. China's electricity consumption alone is projected to triple, growing by an average of 5.5 percent per year over the forecast period. Similarly, in Central and South America, high rates of economic growth are expected to improve standards of living and increase the demand for electricity for homes, businesses, and industry.

The expected growth rate for electricity use in Central and South America is 3.9 percent per year between 1999 and 2020. For Brazil, the region's largest economy and largest consumer of electricity, electricity use is projected to increase by 3.6 percent per year, with increasing efforts to bring electrification to rural populations that have previously not had access to the national grid.

Thus it is reasonable to believe that that enough money could be made available to finance and operate a SSP system.

Table 1. World Net Electricity Consumption by Region, 1990-2020
(Billion Kilowatthours)

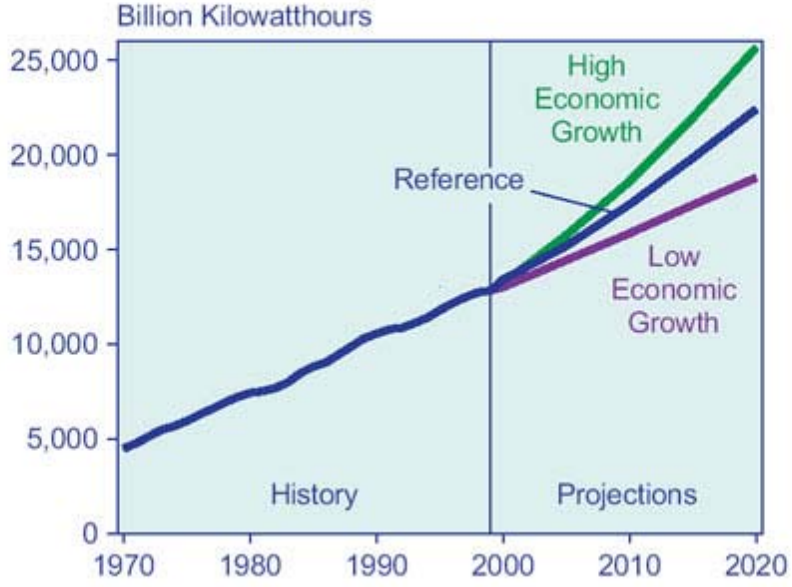
Region	History		Projections				
	1990	1999	2005	2010	2015	2020	Average Annual Percent Change, 1999-2020
Industrialized Countries	**6,385**	**7,517**	**8,620**	**9,446**	**10,281**	**11,151**	**1.9**
United States	2,817	3,236	3,793	4,170	4,556	4,916	2.0
EE/FSU	**1,906**	**1,452**	**1,651**	**1,807**	**2,006**	**2,173**	**1.9**
Developing Countries	**2,258**	**3,863**	**4,912**	**6,127**	**7,548**	**9,082**	**4.2**
Developing Asia	1,259	2,319	3,092	3,900	4,819	5,858	4.5
China	551	1,084	1,523	2,031	2,631	3,349	5.5
India	257	424	537	649	784	923	3.8
South Korea	93	233	309	348	392	429	3.0
Other Developing Asia	357	578	724	872	1,012	1,157	3.4
Central and South America	449	684	788	988	1,249	1,517	3.9
Total World	**10,549**	**12,833**	**15,182**	**17,380**	**19,835**	**22,407**	**2.7**

Note: EE/FSU = Eastern Europe and the former Soviet Union.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 1999*, DOE/EIA-0219(99) (Washington, DC, February 2001). **Projections:** EIA, World Energy Projection System (2002).

International Energy Outlook 2002

Figure 74. World Net Electricity Consumption in Three Cases, 1970-2020



Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use, International Statistics Database and *International Energy Annual 1999*, DOE/EIA-0219(99) (Washington, DC, February 2001). **Projections:** EIA, World Energy Projection System (2002).

History of the ITU

To gain some historical perspective for how regulation of SSP may evolve, it may be instructive to consider the history of the International Telecommunications Union

On 24 May 1844, Samuel Morse sent his first public message over a telegraph line between Washington and Baltimore, and through that simple act, ushered in the tele-communication age.

Barely ten years later, telegraphy was available as a service to the general public. In those days, however, telegraph lines did not cross national borders. Because each country used a different system, messages had to be transcribed, translated and handed over at frontiers, then re-transmitted over the telegraph network of the neighboring country.

Given the slow and unwieldy nature of this system, many countries eventually decided to establish arrangements that would facilitate interconnection of their national networks. However, because each country at a national level managed such arrangements, setting up telegraph links often required a huge number of separate agreements. In the case of Prussia, for example, no less than fifteen agreements were required for the link between the capital and the frontier localities bordering other German States. To simplify matters, countries began to develop bilateral or regional agreements, so that by 1864 there were several regional conventions in place.

The continuing rapid expansion of telegraph networks in a growing number of countries finally prompted 20 European States to meet to develop a framework agreement covering international interconnection. At the same time, the group decided on common rules to standardize equipment to facilitate international interconnection, adopted uniform operating instructions which would apply to all countries, and laid down common international tariff and accounting rules.

On 17 May 1865, after two and a half months of arduous negotiation, the 20 founding members signed the first International Telegraph Convention in Paris, and the *International Telegraph Union* (ITU) was established to facilitate subsequent amendments to this initial agreement. Today, some 135 years later, the reasons that led to the establishment of ITU still apply, and the fundamental objectives of the organization remain basically unchanged.

Following the patenting of the telephone in 1876 and the subsequent expansion of telephony, the International Telegraph Union began, in 1885, to draw up international legislation governing telephony. With the invention in 1896 of wireless telegraphy — the first type of radio communication — and the utilization of this new technique for maritime and other purposes, it was decided to convene a preliminary radio conference in 1903 to study the question of international regulations for radiotelegraph communications. The first International Radiotelegraph Conference held in 1906 in

Berlin signed the first International Radiotelegraph Convention, and the annex to this Convention contained the first regulations governing wireless telegraphy. These regulations, which have since been expanded and revised by numerous radio conferences, are now known as the *Radio Regulations*.

The year 1920 saw the beginning of sound broadcasting at the improvised studios of the Marconi Company, and in 1927, the International Radio Consultative Committee (CCIR) was established at a conference held in Washington D.C. The International Telephone Consultative Committee (CCIF, set up in 1924), the International Telegraph Consultative Committee (CCIT, set up in 1925), and the CCIR were made responsible for coordinating the technical studies, tests and measurements being carried out in the various fields of telecommunications, as well as for drawing up international standards.

The 1927 International Radiotelegraph Conference also allocated frequency bands to the various radio services in existence at the time (fixed, maritime and aeronautical mobile, broadcasting, amateur and experimental), to ensure greater efficiency of operation in view of the increase in the number of radio communication services and the technical peculiarities of each service.

At the 1932 Madrid Conference, the Union decided to combine the *International Telegraph Convention* of 1865 and the *International Radiotelegraph Convention* of 1906 to form the *International Telecommunication Convention.* It was also decided to change the name of the Union to *International Telecommunication Union.* The new name, which came into effect on 1 January 1934, was chosen to properly reflect the full scope of the Union's responsibilities, which by this time covered all forms of wire line and wireless communication.

A In 1947, after the Second World War, ITU held a conference in Atlantic City with the aim of developing and modernizing the organization. Under an agreement with the newly created United Nations, it became a UN specialized agency on 15 October 1947, and the headquarters of the organization were transferred in 1948 from Bern to Geneva. At the same time, the International Frequency Registration Board (IFRB) was established to coordinate the increasingly complicated task of managing the radio-frequency spectrum, and the Table of Frequency Allocations, introduced in 1912, was declared mandatory.

In 1956, the CCIT and the CCIF were merged to form the International Telephone and Telegraph Consultative Committee (CCITT), in order to respond more effectively to the requirements generated by the development of these two types of communication.

The following year was marked by the launch of the first artificial satellite, Sputnik-1, and the beginning of the space age. In 1963, the first geostationary communications satellite (Syncom-1) was put into orbit following the suggestion, made by writer Arthur C. Clarke in 1945, that satellites could be used for the transmission of information.

In order to meet the challenges of new space communications systems, in 1959 CCIR set up a study group responsible for studying space radio communication. In addition, an Extraordinary Administrative Conference for space communications was held in 1963 in Geneva to allocate frequencies to the various space services. Subsequent conferences made further allocations and put in place regulations governing the use, by satellites, of the radio-frequency spectrum and associated orbital slots. In 1992, allocations were made for the first time to serve the needs of a new kind of space service using non-geostationary satellites, known as Global Mobile Personal Communications by Satellite (GMPCS). The same year, spectrum was identified for IMT-2000, the ITU-developed next-generation global standard for digital mobile telephony. Due for commercial implementation early in this new millennium, IMT-2000 will harmonize the incompatible mobile systems currently in use around the world while providing a technical foundation for new, high-speed wireless devices capable of handling voice, data and connection to online services such as the Internet.

In 1989, the Plenipotentiary Conference held in Nice recognized the importance of placing technical assistance to developing countries on the same footing as its traditional activities of standardization and spectrum management. To this end, it established the Telecommunication Development Bureau (BDT) to step up efforts being made to improve communications in the developing regions of the world. At the same time, against a background of increasing globalization and the gradual liberalization of world telecommunication markets, the Nice Plenipotentiary Conference initiated a re-evaluation of the Union's structures, operation, working methods and the resources allocated to enable it to achieve its objectives. The conference established a committee of experts whose task was to make recommendations on changes that would ensure that the Union continued to respond effectively to the needs of its members. In 1992, a plenipotentiary conference, known as the Additional Plenipotentiary Conference, took place in Geneva and dramatically remodeled ITU, with the aim of giving it greater flexibility to adapt to today's increasingly complex, interactive and competitive environment.

As a result of the reorganization, the Union was streamlined into three Sectors, corresponding to its three main areas of activity — Telecommunication Standardization (ITU-T), Radio communication (ITU-R) and Telecommunication Development (ITU-D). The new system also introduced a regular cycle of conferences to help the Union rapidly respond to new technological advances.

The Kyoto Plenipotentiary Conference in 1994 adopted the first-ever strategic plan for ITU, which advocated a more client-oriented approach and a program of activities centred around the changing roles, needs and functions of ITU members. In addition, the Kyoto conference identified a need for a forum where members engage in broad, informal discussions on global telecommunication policies and strategies. It thus established the World Telecommunication Policy Forum (WTPF), an ad hoc meeting which encourages the free exchange of ideas and information on emerging policy issues arising from the changing telecommunication environment. The first WTPF was held in Geneva in 1996 on the theme of global mobile personal communications by satellite, and the second in Geneva in 1998, on trade in telecommunication services.

The Union's most recent plenipotentiary conference, held in Minneapolis from 12 October to 6 November 1998, focused on strengthening the participation of the private sector in the work of the Union, and adopted a number of resolutions which enhance the rights of Sector Members, as well as measures to provide ITU with the flexibility and latitude needed to match the industry's time-frames and operational practices. The conference approved the establishment of a new World Summit on the Information Society, and called for greater ITU participation in the evolution of the Internet as a means of global communication.